Teanaway Temperature Total Maximum Daily Load

Submittal Report

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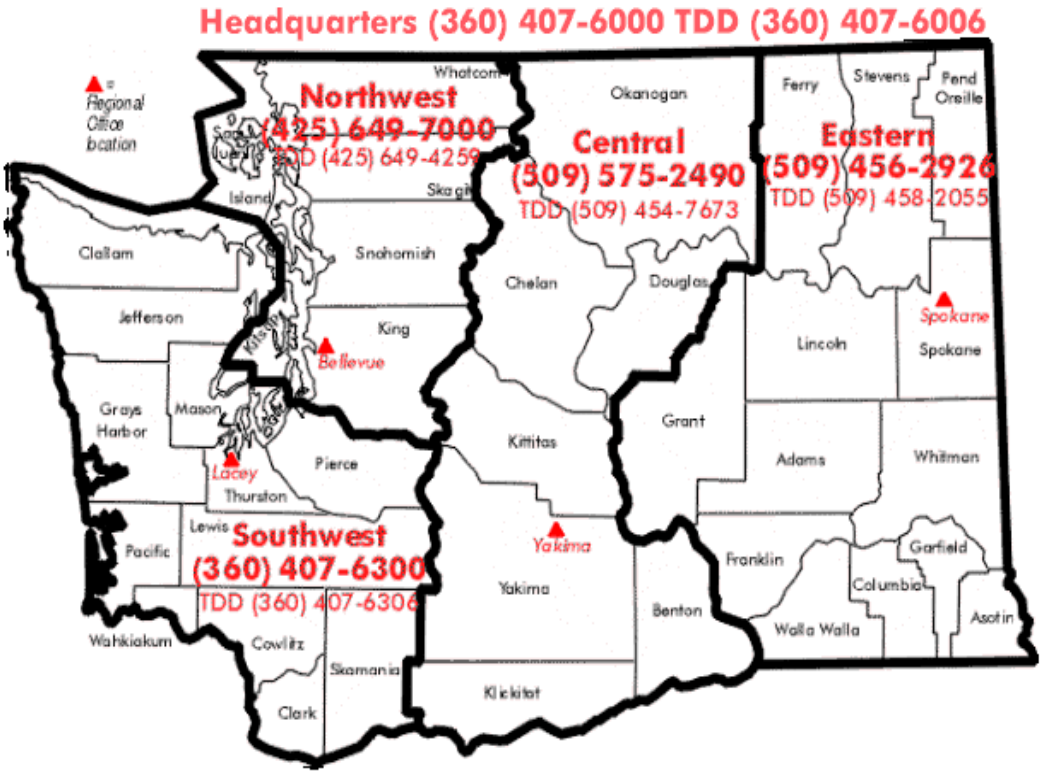

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Executive Summary

Basin:	Upper Yakima
Sub-basin:	Teanaway
Key Impaired Resources:	Chinook Salmon Resident Rainbow Trout Steelhead Trout, Bull Trout
Uses Affected:	Salmonid Fish Migration, Spawning and Rearing
Type of Impairment:	Elevated Water Temperature
Pollutant:	Heat (Solar Radiation)
Contribution Factors:	Reduced Riparian Shade, Sediment, Reduced Streamflow

The Teanaway River basin drains an area of 207 square miles and is located east of the Cascade crest near the town of Cle Elum, Washington. The Teanaway, considered a 5th code Hydrologic Unit (HUC) by EPA, lies in the upper reaches of the larger Yakima River watershed.

The climate consists of warm, dry summers and cold, snowy winters. Annual precipitation ranges from 20 inches near the mouth of the Teanaway River (elevation 1,800 feet) to 90 inches in the high mountains (elevation 6,000 feet). Peak runoff events are of two kinds: rain-on-snow precipitation events between November and February, and high flows associated with spring snow melt in April and May. The 1971-1998 period of record show a peak flow of 8,000 cfs and a low flow of 6 cfs, with an average annual peak of 1,000 cfs and an average annual seven- day low of 15 cfs.

Major land uses and ownership can generally be described by dividing the watershed into thirds. The upper one third of the watershed lies in the Wenatchee National Forest and is managed by the U.S. Forest Service. Much of the middle one third of the watershed is owned and managed by private timber companies, with land adjacent to the middle and north forks often in light agricultural range land. The lower one third of the watershed, below the west, middle and north forks, supports hay, feed crops, and livestock, and timber management in the surrounding hills.

The streams in the Teanaway River basin are prone to heating due to low flows, hot summer weather, and wide shallow streams with low riparian shade. In addition, many of the channels are scoured to bedrock substrate which tends to retain heat. Accordingly, several reaches of the Teanaway River and its tributaries do not meet Washington State's numeric water quality standards for stream temperature. As a result, these stream segments have been placed on Washington State's list of impaired water bodies (the 303(d) list).

The Federal Clean Water Act requires that a total maximum daily load (TMDL) analysis be completed for all impaired waters on the 303(d) list. This document is the temperature TMDL for the Teanaway River basin. This TMDL is designed in an attempt to identify possible causes of impairments to surface water temperature on eight stream segments in the Teanaway

watershed, to quantify these, and to identify actions that can be implemented to meet Chapter 173-201A WAC Water Quality Standards for Surface Waters of the State of Washington. Data from the early 1990s showed that stream temperatures in the Teanaway River basin regularly exceeded state numeric criteria for water temperature. This was confirmed by measurements made during the summer of 1998, when temperatures exceeded numeric standards on more than 93% of the days studied (July through September).

Washington State's water quality standards require that when "natural conditions" for temperature exceed the numeric standards human actions may not increase stream temperatures by more than 0.3°C above the natural conditions. Natural conditions are described as conditions that would exist prior to human activities. However, when the natural conditions of the Teanaway River and its tributaries are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria.

Using extensive data collected during the summer of 1998 and a computer model (Stream Segment Temperature Model [SSTEMP]), Ecology estimated the magnitude and relative importance of human impact of stream temperature in the Teanaway. The study did not attempt to specify what stream temperatures constitute natural conditions, except to determine that they probably exceed the numeric criteria. Stream temperature is determined by a complex interaction of external influences and stream specific, internal hydrologic processes. The modeling approach used in the Teanaway Temperature TMDL analysis considers some of these factors, but available information is insufficient to estimate what temperatures may have existed in this watershed prior to anthropogenic influences. Ecology recognizes that it is not reasonable to return this watershed to conditions that existed prior to human presence. Instead, the study focused on the potential benefits gained by reducing primary known impacts on stream temperature.

Ecology's technical study estimated that under critical conditions, establishing a mature riparian stream corridor could result in shading that reduces the Teanaway's maximum daily temperature by approximately 3° C. Reducing sediment loading to a stream by establishing a mature riparian corridor and through improved road maintenance is expected to decrease stream width and thereby reduce maximum daily stream temperature by an additional 0.5°C to 1°C. Increasing flow in the mainstream was also demonstrated to decrease stream temperatures.

In addition to providing shading, a mature riparian corridor is expected to allow growth of vegetation that can stabilize the bank during high flows, dissipate stream energy, reduce the amount of bank cutting, and provide additional filtering of sediment loading to the river. There are additional unquantifiable benefits to stream temperature that have not been addressed in this study, but are possible as a mature riparian buffer is established. Some of these are:

- Addition of large woody debris to the stream, which forms pools and traps sediment.
- Additional root structure, which provides support for smaller vegetation, which in turn provides additional stream shading.
- Gravel bed shading, which results in cooler conditions for water moving under or through those gravels.

- Cooling of ambient air temperature (because air temperature under a mature riparian canopy is usually lower than that over bare or sparsely covered ground), which further reduces heat transfer to the stream.

The TMDL study demonstrated that further reductions in stream flow, in the absence of any other actions, can negatively impact stream temperatures. With guidance from an advisory group, actions are being considered and implemented to help minimize these impacts.

Effective reduction of stream temperatures will depend on increases in riparian shade, enhancing natural stream morphology (e.g. increased channelization) and reductions in active channel width. Alternate methods of storing water in the Teanaway Basin and voluntary opportunities to increase stream flow will also be considered. Implementation of this TMDL is based on existing rules and regulations and the voluntary actions of property owners with lands adjacent to streams. Voluntary efforts include restoring native vegetation along riparian corridors and preventing bank erosion. Additional studies of temperature, sediment loading and impacts on stream morphology are proposed. Monitoring will be used to establish a baseline for future analysis.

Introduction

Section 303(d) of the Federal Clean Water Act mandates that the state establish Total Maximum Daily Loads (TMDLs) for surface waters that do not meet standards after application of technology-based pollution controls. The U.S. Environmental Protection Agency (EPA) has established regulations (40 CFR 130) and developed guidance (EPA, 1991) for setting TMDLs.

Under the Clean Water Act, every state has its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of 1) designated uses, such as supporting cold water biota and providing a drinking water supply, and 2) criteria, usually numeric, to achieve those uses. When a lake, river or stream fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires the state to place the water body on a list of "impaired" water bodies and to prepare an analysis called a **Total Maximum Daily Load (TMDL)**.

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the sources that cause them. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards; this is called the loading capacity. The TMDL also allocates that load among the various sources.

The TMDL also must consider seasonal variations and include a margin of safety that takes into account any lack of knowledge about the cause of the water quality problem or its loading capacity. The sum of the individual allocations and the margin of safety must be equal to or less than the loading capacity.

In addition to the mandatory components of a TMDL, the general purposes of this document are to:

- Summarize data that document the stream segments exceeding state standards for temperature,
- Summarize the results of a technical assessment performed to identify probable primary sources of heat pollution that cause stream temperature increases and an estimate of the magnitude of those impacts on stream temperature (per the "Teanaway River Basin Temperature Pilot Technical Assessment" [Stohr, 2000],
- Summarize actions recommended for meeting water quality standards,
- Summarize monitoring that should be used to track TMDL implementation and determine progress toward attaining water quality standards, and

A Detailed Implementation Plan (DIP) will be developed within a year of TMDL approval as a result of information in this document. Further public input will be sought to help prepare this plan, which will identify how, when, and where voluntary restoration activities will be implemented. Details of a monitoring plan will be developed. Ecology and other entities will provide technical assistance and seek additional funding for these activities.

Components of the TMDL

This Total Maximum Daily Load (TMDL) for temperature in the Teanaway River basin addresses the seven segments of the north, west, middle and main forks of the Teanaway, plus Stafford Creek, as included on the 1996 and 1998 Section 303(d) lists of impaired surface waters.

The five components of a TMDL, as required by the Clean Water Act and applied to this TMDL, are described below:

Loading capacity

The loading capacity is the amount of pollutant that a waterbody can receive without violating water quality standards. The loading capacity for this study includes natural background, waste load allocations, load allocations, and a margin of safety. In the Teanaway River basin, the water quality standard that has been impaired is temperature, and the pollutant is heat. The primary source of temperature increases are those that increase the amount of solar radiation reaching the stream surfaces. The most important of these activities is the reduction of streamside shade. Also of importance are contributions to sediment loads and reduced bank stability, which can cause artificial widening of the river. In addition, reductions in flow reduce the stream's capacity to assimilate heat loads.

The loading capacity was determined specifically for the eight streams on the 303(d) list and more generally for the remaining perennial streams based on Rosgen channel type. The model used in Ecology's study predicted that in most cases the achievable shade was less than that needed to meet the State's numeric surface water temperature standards (of 16 and 18°C). Therefore, the loading capacity for most segments is based instead on "site potential shade". Site potential shade is the shade that is achievable with a mature riparian forest and a return of active channel zone width to more natural conditions. Return of stream channel to more natural conditions is expected to occur through increased bank stability and reduced contributions of sediment. The solar radiation loading capacities were estimated to range from 93-189 joules per square meter of water surface area per second ($j/m^2/s$). The loading capacity is based on existing flows.

Wasteload allocation

The wasteload allocation is the amount of a receiving water's loading capacity that is allocated to point sources of pollution. Since there are no permitted thermal discharges within the Teanaway River basin (i.e., no point sources), the wasteload allocation for heat is zero.

Load allocations

The load allocation is that portion of a receiving water's loading capacity that is attributed to nonpoint sources of pollution or to natural background sources. In the Teanaway, the load allocations are addressed by using modifications to shade (including impacts to stream width) as

a surrogate for contributions of excess solar radiation. For segments above 3,500 feet in elevation, the allocation is based on shade needed to meet state numeric standards and is estimated to be 33 percent shade. Below that elevation, allocations are for site potential shade, which is estimated to range from 52 percent shade (154 $j/m^2/s$) to 71% shade (93 $j/m^2/s$). Site potential shade includes reduced stream width resulting from increased bank stability and reduced contributions of sediment. The TMDL technical assessment did not determine buffer width needed to achieve the allocations for shade. Nor did it quantify the contributions of sediment. A detailed assessment of the effects of sediment movement and deposition on stream morphology (and thus on stream width and depth) will be recommended as a component of the implementation plan.

Flow is being addressed under water resource laws and regulations, voluntary conservation measures, and local Watershed Planning efforts.

Margin of safety

The margin of safety accounts for uncertainty about pollutant loadings and waterbody response. In this TMDL, the margin of safety is addressed by using critical climatic conditions in the modeling analysis. Climatic conditions measured on July 28, 1998 were used in this analysis. The air temperature measured on this day represents the 95^{th} percentile of maximum July and August air temperatures in Cle Elum, Washington for 1995-1998. In addition, the computer model used for the analysis, SSTEMP, tended to be slightly over predict the maximum daily water temperatures during the critical condition, which resulted in conservative shade values.

Seasonal variation

The TMDL must account for seasonal variation. The majority of temperature exceedences and low flows occur in July and August. Since it is not possible to change allocations of shade over a year, allocations were set based on this critical summer period. Seasonal variations of expected instream flows also must be considered.

Background

The Teanaway River basin drains an area of 207 square miles and is located east of the Cascade crest, in Kittitas County, near the town of Cle Elum, Washington. Location of this watershed and land uses are displayed in Figure 1.

The climate consists of warm, dry summers and cold, snowy winters. Annual precipitation ranges from 90 inches in the high mountains (elevation 6,000 feet) to 20 inches near the mouth of the Teanaway River (elevation 1,800 feet). Peak runoff events are of two kinds: rain-on-snow precipitation events between November and February and high flows associated with spring snowmelt generally in April and May. Streamflow information is available for the U.S. Bureau of Reclamation (USBR) gage located on the Teanaway River below the confluence of the three major forks. The gage is upstream of major irrigation diversions, and monitors the flow off of approximately 172 square miles. The 1971 - 1998 period of record shows a peak flow of 8,000 cubic feet per second (cfs) and a low flow of 6 cfs, with an average annual peak of 1000 cfs and an average annual 7-day low flow of 15 cfs.

Major land uses and ownership can generally be described by dividing the watershed into thirds. The upper one-third of the watershed lies in the Wenatchee National Forest and is managed by the U.S. Forest Service (USFS). Much of the middle one-third of the watershed is owned and managed by private timber companies, with land adjacent to the Middle and North forks often in light agricultural or range land. The lower one-third of the watershed, below the West, Middle, and North forks, supports hay, feed crops, livestock and timber management in the surrounding hills. The primary private timber owners in the basin are U.S Timberlands and Plum Creek.

Land Survey Office (LSO) notes from the 1880s generally describe vegetation near the lower Teanaway River as pine and fir (or pine, cottonwood and alder). “Undergrowth same with vine maple, crab apple and rose bush.” All of the forest stands in the Teanaway basin below the USFS boundary have been harvested at least once and many areas have been logged two or three times since 1903. Past logging practices have included the use of splash dams and the construction of railroads parallel to or in the streambeds themselves. (Splash dams were used to impound water on small streams. The water from several dams was released in a coordinated fashion to supply a "tide" of water to float large logs.) These activities have significantly altered stream morphologies, bank stability, hydrology, and sediment loads.

Historically, fire has played an important role in forest habitats east of the Cascades (Plummer, 1902). Forest stands that were experiencing fire every generation in the Teanaway watershed are now devoid from this level and kind of disturbance. Fire suppression has resulted in an increase in the number of trees and forest floor fuel loading in eastern Washington as well as a shift in forest composition to less fire resistant tree species (Kauffman 1990).

The Teanaway River basin has been used for agriculture since the early 1880s. Beginning in 1920, Cascade Lumber leased land for cattle and sheep in the North Fork Teanaway basin. The number of cattle has fluctuated in size and today some cattle are grazed in the North Fork basin, with a small number of additional cattle grazing in the West Fork basin. Feed crops and hay are grown adjacent to the Teanaway River and its tributaries.

Domestic water is provided by wells, and irrigation water is provided by surface water withdrawals. Water is exchanged between the shallow aquifer adjacent to the river and the surface water flowing in the river. This hydraulic continuity provides important cooling to surface waters when the groundwater flows into the river. This connection also means that surface water flow can be expected to decrease if additional water is withdrawn from this aquifer. Water in this shallow aquifer has been identified as suitable for irrigation. Withdrawal for irrigation purposes typically occur during the time of year when this groundwater is most needed to help maintain river flow and provide cooling of surface waters.

Anadromous species that occur in the basin include spring-run chinook salmon *(Oncorhynchus tshawytsch*a) and steelhead trout *(O. mykis*s). Resident species include brook trout *(Salvelinus fontinali*s), rainbow trout *(O. mykis*s), cutthroat trout *(O. clark*i), and bull trout *(S. confluentu*s). The Washington Department of Fish and Wildlife (WDFW) manages the Teanaway basin primarily for anadromous species. In 1999, steelhead and bull trout were designated as "threatened" under the Endangered Species Act, in areas that include the Teanaway River basin.

Deposition of sediment to streams affects stream temperature by contributing to the widening and shallowing of a stream. This increased width to depth ratio makes the stream more vulnerable to heating from solar radiation due to a larger water surface area. Sediment sources in the basin include roads, logging and agriculture practices, landslides, and natural conditions.

The streams in the Teanaway River basin are prone to heating during July and August, due to low flows, hot weather, and wide shallow streambeds with low riparian shade. High temperatures are detrimental to use by fish and other aquatic biota.

Much of the information presented in the following sections can be found in the "Teanaway River Basin Temperature Pilot Technical Assessment" (Stohr, 2000).

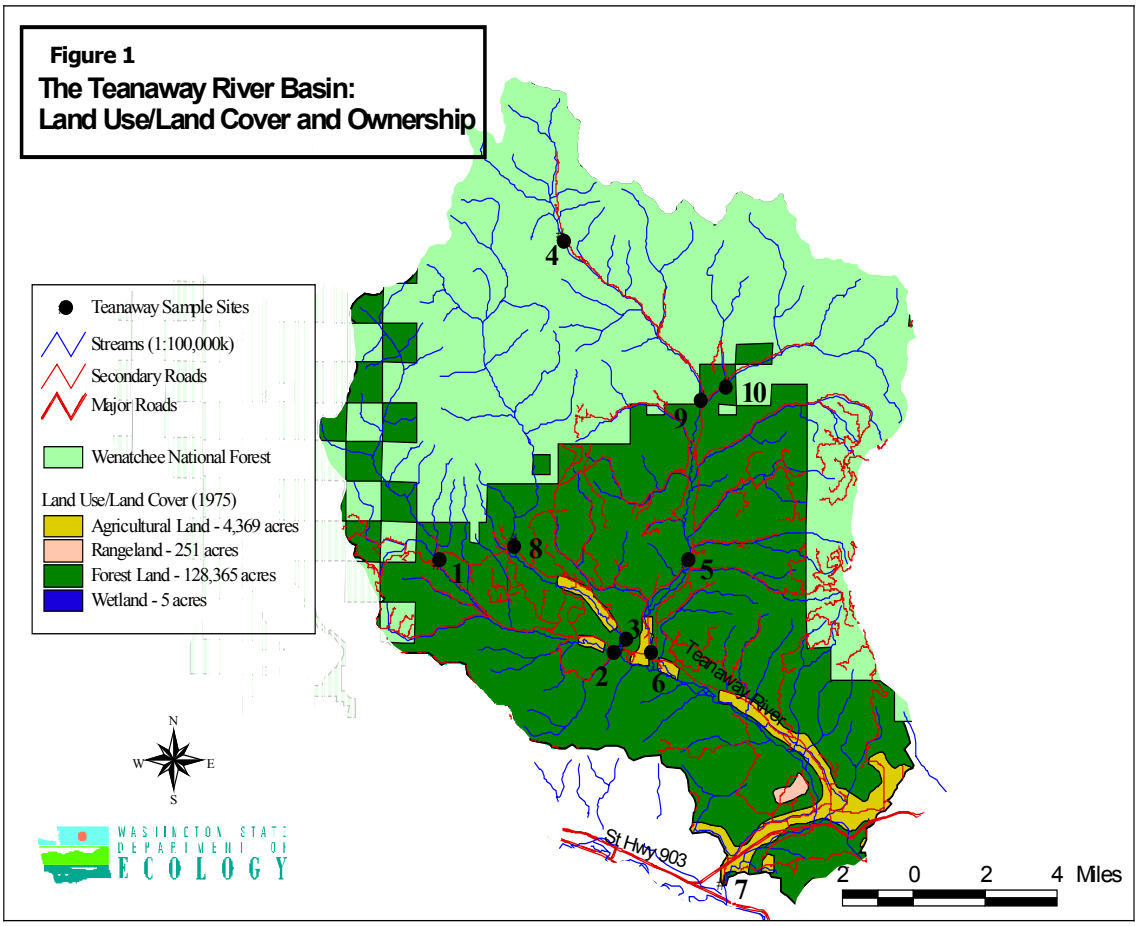
Figure 1
The Teanaway River Basin:
Land Use/Land Cover and Ownership
Teanaway Sample Sites
Streams (1:100,000k)
Secondary Roads
Major Roads
Wenatchee National Forest
Land Use/Land Cover (1975)
Agricultural Land - 4,369 acres
Rangeland - 251 acres
Forest Land - 128,365 acres
Wetland - 5 acres
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Applicable Criteria

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt such rules, regulations, and standards as are necessary to protect the environment is vested with the Department of Ecology. Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the state (Section 303(c)(3)). Through adoption of these water quality standards, Washington has designated certain characteristic uses to be protected and the criteria necessary to protect these uses [Washington Administrative Code (WAC), Chapter 173-201A].

Streams in the Teanaway watershed are designated as Class AA on US Forest Service lands and Class A elsewhere in the basin.

This TMDL is designed to address impairments of characteristic uses caused by high temperatures. The characteristic uses designated for protection in Teanaway River basin streams are as follows (Chapter 173-201A WAC):

"Characteristic uses. Characteristic uses shall include, but not be limited to, the following:

(i) Water supply (domestic, industrial, agricultural).

(ii) Stock watering.

(iii) Fish and shellfish:

Salmonid migration, rearing, spawning, and harvesting.

Other fish migration, rearing, spawning, and harvesting.

Clam and mussel rearing, spawning, and harvesting.

Crayfish rearing, spawning, and harvesting.

(iv) Wildlife habitat.

(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).

(vi) Commerce and navigation."

The state water quality standards describe criteria for temperature for the protection of characteristic uses. The numeric temperature criteria for Class AA or Class A streams are described below.

For Class AA waters:

"Temperature shall not exceed 16.0°C… due to human activities. When natural conditions exceed 16.0°C…, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C."

For Class A waters:

"Temperature shall not exceed 18.0°C… due to human activities. When natural conditions exceed 18.0°C…, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C."

Water Quality and Resource Impairments

Stream temperature data collected in the Teanaway River basin during the early 1990s, and submitted by the USFS and the Yakama Nation, showed numerous excursions above the state numeric criteria for temperature. Eight stream segments in the Teanaway basin were therefore included on Washington State's 1996 and 1998 303(d) lists of impaired waterbodies (see Table 1).

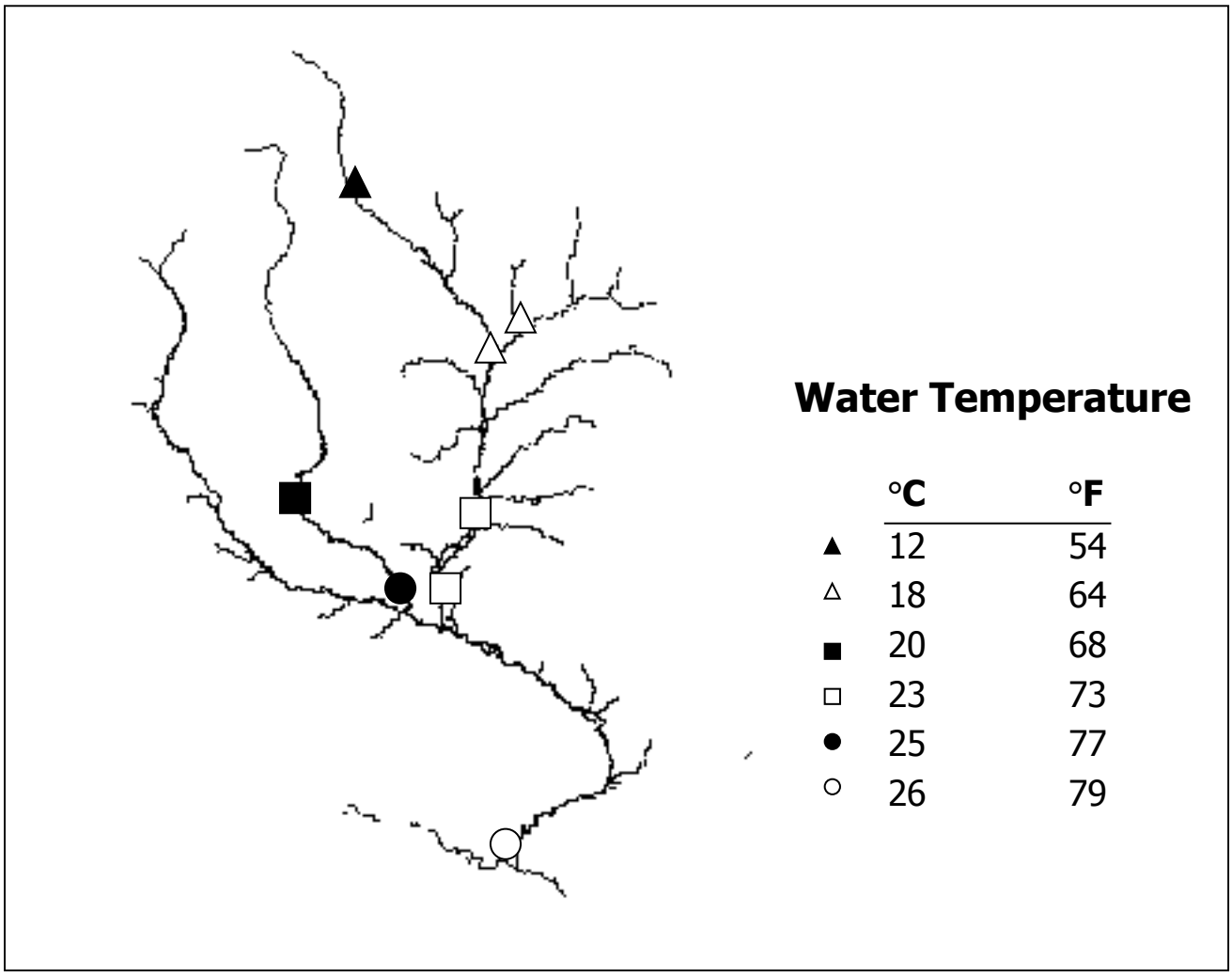
In the summer of 1998, Ecology and the USFS collected hourly measurements of stream temperatures throughout the Teanaway basin at the locations shown on Figure 1. Table 2 and Figure 2 provide a summary of the result. Detailed results for monitoring sites may be found in Appendix A of the Technical Assessment (Stohr, 2000). The results show that temperatures exceeded numeric temperature criteria up to 93 percent of the summer days (July through September, 1998).

Table 1. Teanaway basin Section 303(d) stream segments listed for temperature

Section 303(d) listed segment	Water Class	Numeric temperature standard* (^{o}C)	Water Body ID	
			1996 ID	1998 ID
Upper West Fork Teanaway River	AA	16	WA-39-2350	OD70SN
Upper Middle Fork Teanaway River	AA	16	WA-39-2250	KB71OY
Upper North Fork Teanaway River	AA	16	WA-39-2150	TI29YR
Stafford Creek	AA	16	WA-39-2155	IY03YA
Lower West Fork Teanaway River	A	18	WA-39-2300	OD70SN
Lower Middle Fork Teanaway River	A	18	WA-39-2200	KB71OY
Lower North Fork Teanaway River	A	18	WA-39-2100	TI29YR
Mainstem Teanaway River	A	18	WA-39-2000	ZH39IA

* Where the stream temperature exceeds numeric standards, natural conditions (plus 0.3^{o}C) apply.

Figure 2. Average daily maximum water temperature, July 22 to August 11, 1998



Technical Approach and Results

The following describes the technical approach used, the data collected and the results of the analysis, which form the technical basis for this TMDL. Additional information about this analysis may be found in the "Teanaway River Basin Temperature Pilot Technical Assessment" (Stohr, 2000).

The intent of the approach was to evaluate the major impacts on stream temperature, with the goal of identifying and implementing activities to be taken to attain state water quality standards. It is expected that activities will focus on returning streams to natural conditions through natural processes, but use of mechanical or artificial methods to supplement natural processes, such as stream channelization, are not excluded.

When a stream surface is exposed to solar radiation, large quantities of heat are delivered to the stream system. When the entire surface is shaded throughout the entire duration of the daily solar cycle, far less heat energy is transferred to the stream. Activities that cause excess solar radiation to reach the stream surface include:

- Disturbing or removing riparian vegetation that provides shade; and
- Damage to bank stability and increases to sediment load that cause channel widening.

This study evaluated the reductions in heat loads and associated temperatures that could be achieved if these processes were reversed and the stream returned to near natural conditions. For the purposes of this study, the shade provided by this return to natural conditions was termed “site potential shade”. Site potential shade is therefore the shade that is achievable with mature riparian vegetation and a return of active channel zone width to more natural conditions. Active channel zone width is the water surface width plus adjacent channel bed, and unvegetated bars and/or terraces. Reduced contributions of sediment and increased bank stability are linked to reductions in active channel zone width.

Other processes associated with the return to mature riparian vegetation are expected to further reduce stream temperatures. These processes include:

- Increase of large woody debris to the stream, which forms pools and traps sediment.
- Root structure that provides additional support for smaller vegetation, which in turns provides additional shade.
- Gravel bed shading, which results in cooler conditions for water moving under or through those gravels.
- Cooler ambient air temperature (because air temperature under a mature canopy is usually lower than that over bare or sparsely covered ground), which causes a further reduction in heat transfer to the stream.

A natural process that might act to counter the establishment of vegetation in the riparian zone is an extreme high flow event. However, a healthy riparian zone can provide additional bank stability, slow the movement and associated disruptive force of flood waters, and decrease the

magnitude of downstream flood peaks. As the health of a watershed improves, the destructive power of floods should decrease. Long-term monitoring will be required to determine actual temperature reductions that can be realized from the above processes.

Reduction of summertime stream flow also contributes to an increase in stream temperature. This is because the process of transferring heat from the air to a water body of a fixed surface area is faster for a smaller volume of water. Also, a smaller volume of water can assimilate less heat before its temperature increases. Effects of reduced flow were evaluated in general terms, but, because of the complexity of the hydrologic system in the lower valley, further studies would be needed to better quantify these impacts. Such studies should address multiple surface water intakes, groundwater withdrawals, surface and subsurface return flows and evapotranspiration.

Data Collection

Data was collected at ten established sites within the watershed during the summer of 1998 (see Figure 1). Water temperatures were monitored hourly at eight stations in the basin; air temperature at six stations; and continuous flow data were available from two sites. Temperature and streamflow measurements were also taken during field visits.

Shade, bankfull width and depth, wetted width and depth, stream surface slope, and a Wohman pebble count were measured at each site. Additional data included Rosgen evaluation, elevation, stream azimuth, and number of road miles within 200 feet of a perennial stream. These measurements were supplemented with data from Timber, Fish and Wildlife (TFW) watershed analyses; TFW survey data; and aerial and orthophotos.

Monitoring results show that except for the highest altitude site, all measured sites exceed state numeric standards for stream temperature. Table 2 shows the water temperature results for the summer of 1998. Figure 2 shows the average daily maximum temperature for two weeks in the middle of the summer of 1998. Additional results for water and air temperature are provided in the Technical Assessment (Stohr, 2000).

Table 2. Water temperature results, summer 1998 (July 1 - October 6)

Stream Segment	Monitoring Station	Numeric Standard (^oC)	Days Exceeding Numeric Standard (number)	Days Exceeding Numeric Standard (%)	Maximum Temperature (^oC)
Stafford Creek	10	16	30	31	19.4
Headwaters of North Fork	4	16	0	0	13.3
Upper North Fork	9	16	46	48	19.8
Lower North Fork	5	18	74	77	24.4
Lower North Fork	6	18	79	82	25.3
Upper Middle Fork	8*	16	28*	90*	21.9
Lower Middle Fork	3	18	89	93	26.3
Mainstem	7	18	82	85	28.5

* Results are for the 31 days in July because the monitor came out of the water around August 8, 1998.

Groundwater gain and loss in the downstream direction was estimated using continuous stream gage measurements and flow measurements taken at the monitoring sites during the field season.

Data Analysis

SSTEMP (Stream Segment Temperature Model), a one-dimensional steady-state stream temperature model, was used to evaluate the effects of riparian shade, channel width, and streamflow on stream temperature in individual stream segments. SSTEMP is a well-documented model maintained by the Biological Research Division of the U.S. Geological Survey (USGS). The program predicts the minimum, mean, and maximum daily water temperatures at a specified distance downstream. SSTEMP is known to be quite accurate at predicting mean daily temperature, but is less reliable at predicting maximum daily temperature.

SSTEMP was calibrated to existing conditions, then used to estimate what temperatures might be achievable using site potential shade. Calculations were made for the critical conditions, which is when pollutant loading has the greatest potential to exceed state water quality standards. For this analysis, the critical condition was during the hottest three days of the summer of 1998. Correlation between predicted and measured stream temperatures showed an R^2 of 0.95 for the mean daily water temperature and 0.88 for the maximum daily water temperature.

Improvements in riparian condition, bank stability, and road maintenance are expected to reduce sediment input to the stream, resulting in a reduction in active channel zone width. Initial studies by Ecology show that the Teanaway River is one of the highest springtime contributors of suspended sediment to the Yakima River in the Upper Yakima basin. Using the Rosgen method, it was estimated that a 30 precent reduction in the active channel zone width might be achieved by increased bank stability, and elimination of past and current contributions of sediment, both

suspended sediment and bedload. Additional studies of sediment loading and impacts on stream morphology are proposed.

Predicted temperature reductions are based on the assumption that background conditions stay constant, with regard to land management practices and water use. These were not addressed in this study, but may need to be addressed at a future time.

Some areas of the watershed that have not been heavily harvested and do not contain roads, specifically the upper Middle Fork of the Teanaway, may already be approaching their natural condition. Further study would be necessary to make this determination.

Loading Capacity

The loading capacity is the amount of pollutant (or "load") that a waterbody can receive without violating water quality standards. In the Teanaway River basin, the water quality standard that has been impaired is temperature, and the pollutant is heat. The primary source of temperature increases are those that increase the amount of solar radiation reaching the stream surfaces. To address the technical requirements for a TMDL, loading of this excess solar radiation was calculated, in terms of heat (joules/m^2/s) (see Tables 3 and 4). It should be noted that different reaches of the river have different loading capacities.

As discussed earlier, for this study, streamside shade was used as a surrogate for excess solar radiation. Therefore, the loading capacity also is expressed as the amount of shade needed to attain temperature standards. Where the numeric criteria cannot be met, natural conditions apply and full site potential shade is needed. This is the case in much of the Teanaway basin. The estimated percentage shade needed to meet numeric temperature standards and natural conditions is provided in Tables 3 and 4.

As stated above, the loading capacity is the amount of pollutant that a waterbody can receive without violating water quality standards. When the amount of pollutant already being received causes the standards to be exceeded, it may be helpful to think of the "loading capacity" in terms of a loading deficit; that is, rather than a capacity to handle any contributions without exceeding standards, it is the amount of pollutant that needs to be removed in order to attain the state's water quality standards (Chapter 173-201A WAC).

The loading capacity is based on existing water uses in the basin.

Table 3. Shade and heat loads for stream segments on North Fork and Mainstem Teanaway River

Stream Reach (and Monitoring Stations)	Existing Shade (%)	Shade Required to Meet Numeric Temperature Standards	Estimated Site Potential Shade (riparian/ riparian & sediment)	Decrease in Current Mean Temperature with Achievable Shade (°C)	Current Solar Load (j/m2/s)	Solar Loading Capacity with Site Potential Shade (riparian/riparian & shade) (j/m2/s)	Required Solar Load Decrease (%)
Headwaters (no station) to Site 4	33	33*	63		213	122	0
Upper North Fork (4 to 9)	46	85*	66 71	1.5 1.9	173	109 93	46
Lower North Fork (9/10 to 5)	11	93**	46 55	1.9 2.4	285	173 144	50
Lower North Fork (5 to 6)	12	100+**	44 54	1.3 1.8	282	179 147	48
Mainstem (6 to 7)	3	100+**	41 52	1.3 1.7	310	189 154	50

* 16^{o}C standard ** 18^{o}C standard

Source: "Table 7. Loading capacity of modeled stream segments" (Stohr, 2000)

Table 4. Shade and heat loads for one-mile segments on Stafford Creek, Middle and West Fork Teanaway River, and tributaries

Stream Reach (and Monitoring Station)	Existing Shade (%)	Shade Needed for No Temperature Gain/Mile (%)	Estimated Site Potential Shade (riparian/ riparian & sediment)(%)	Water Temperature Gain/Mile at Existing Conditions (ºC)	Water Temperature Gain/Mile at Goal Conditions (ºC)	Current Solar Load ($j/m^2/s$)	Loading Capacity with Site Potential Shade ($j/m^2/s$)	Required Solar Load Decrease (%)
Stafford Creek (Site 10)	27	73	70	NA	0.1	233	96	59
Upper Middle Fork (Site 8)	28	55	67	0.7	-0.3	233	105	35
Lower Middle Fork (Site 3)	11	80	57 64	1.7	0.4	284	138 115	59
Upper West Fork (Site 1)	13	55	67	1.1	-0.3	278	105	62
Lower West Fork (Site 2)	29	80	61 68	Similar to Site 3	0.3	228	124 102	55
Other Rosgen B Segments	N/A		70			N/A		
Other Rosgen C Segments	N/A		60			N/A		
All Other Tributaries	N/A		70			N/A		

Source: " Table 8. Loading capacity of one-mile modeled stream segments" (Stohr, 2000).

Load and Wasteload Allocations

The "load allocation" and "wasteload allocation" is the portion of the stream's loading capacity that is designated ("allocated") for each source of pollution. Because there are no point sources, such as wastewater discharges from municipalities or industry, there is no need to develop a wasteload allocation. However in the Teanaway, for all non-point sources of pollution, a load allocation is needed. In the Teanaway, the load is from excess solar radiation; shade is used as the surrogate for contributions of excess solar radiation. As discussed above, the loading capacity is the amount of shade needed to attain temperature standards. In many areas of the Teanaway basin, full site potential shade is needed to meet state water quality standards. Therefore, the load allocation for most areas of the basin is site potential shade. (Site potential shade also includes the reduced channel width associated with streams in near natural conditions, a result of increased bank stability and reduced contributions of sediment.) In a few parts of the basin, mostly at upper elevations, the loading capacity, and hence load allocation, is shade needed to meet the numeric criterion.

Contributions of sediment may include past or current actions that cause widening and shallowing of the channel. A sediment budget that would return or maintain a more natural morphology in the Teanaway has not been determined. However, continued assessment of this factor and its relationship to temperature are recommended as part of the implementation plan.

Flow is being addressed under water resource laws and regulations and voluntary water conservation measures. Under these measures, no additional water rights are being issued; metering systems are being installed to monitor ongoing use; irrigators are implementing water conservation measures; and the US Bureau of Reclamation has provided funds to purchase water rights from willing sellers to return these waters to instream flow. Additional funds are available. The local watershed planning group (the Yakima River Basin Watershed Planning Unit) also is addressing flow needs through the water quantity and fish habitat components.

Seasonal Variation

The TMDL must account for seasonal variation. The majority of temperature exceedences and low flows occur in July and August. Since it is not possible to change allocations of shade over a year, allocations were set based on this critical summer period. Seasonal variations of expected instream flows also must be considered.

Margin of Safety

The margin of safety accounts for uncertainty about pollutant loadings and waterbody response. In this TMDL, the margin of safety is addressed by using critical climatic conditions in the modeling analysis. Climatic conditions measured on July 28, 1998 were used in this analysis. The air temperature measured on this day is the 95th percentile of maximum July and August air

temperatures in Cle Elum, Washington for 1995-1998. In addition, the computer model used for the analysis, SSTEMP, tended to slightly overpredict the maximum daily water temperatures during the critical condition, which resulted in conservative shade values.

Summary Implementation Strategy

This Summary Implementation Strategy ("SIS") identifies the activities to be implemented to meet the state's temperature standards (Chapter 173-201A WAC). These include ongoing voluntary activities and supporting regulations. The three primary physical factors addressed by both activities and supporting regulations are 1) riparian vegetation, which provides shade and bank stability; 2) contributions of sediment (which impacts stream width); and 3) increasing or retaining stream flow in the Teanaway. Additional activities may be proposed during the implementation phase. Tables in Appendix B show some of the ongoing and potential future implementation activities.

This SIS identifies the need for a monitoring plan, to track and evaluate the effectiveness of the implementation measures and to evaluate the need for other measures. A detailed monitoring plan will be developed with the detailed implementation plan.

A Detailed Implementation Plan (DIP) will be prepared within a year following approval of this document. Further public input will be sought to help prepare this plan. The plan will identify how, when, and where voluntary restoration activities will be implemented. It is expected that activities will focus on returning streams to natural conditions and the evaluation and use of mechanical or artificial methods to supplement natural processes, such as stream channelization and alternative storage, are not excluded. Ecology and other entities will provide technical assistance and seek additional funding for these restoration activities and monitoring. It is the goal of this TMDL to meet the water quality temperature standards by 2080.

Activities that Support this TMDL

Past and ongoing activities by the U.S. Bureau of Reclamation (USBR), the Natural Resources Conservation Service (NRCS), the U.S. Forest Service (USFS), Ecology, landowners, and others have supported the goals of this TMDL. These efforts have included riparian restoration, sediment reduction and return of instream flows.

A Teanaway Workgroup has been presented with the Teanaway report. The workgroup includes representatives from government agencies, interest groups, and local landowners. Further support and help from this group will be sought to identify and prioritize implementation activities. It is hoped that its activities will expand over the next few years. Ecology will encourage and assist the local workgroup in implementation and monitoring activities.

Local landowners have initiated many stream improvement projects such as putting in barbs, and most recently (winter/spring 2001) have planted 5,325 trees in riparian areas along 2.7 miles of the Teanaway River. To assist landowners with riparian restoration, Ecology has provided funding for tree planting crews (from the Washington Conservation Corps [WCC]) and native riparian vegetation, through the spring of 2001. The NRCS is coordinating the work. It is hoped that continued funding for this activity can be obtained.

The NRCS sponsors the Conservation Reserve Enhancement Program (CREP). Voluntary participation by local landowners is sought through a cost share program designed to restore and enhance habitat and increase bank stability along waterways on private lands with a cropping history. The program offers payments for annual rental, signing, cost share, practice, and maintenance in exchange for removing land from production and grazing, under 10-15 year contracts.

The NRCS also has funds available, largely through its Environmental Quality Incentives Program (EQIP). EQIP provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program is implemented through conservation plans that includes structural, vegetative, and land management practices. Contracts are five to ten years long. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as exclusion fencing, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management.

The Washington State Legislature has authorized the creation of a Small Forest Landowner Office to provide technical assistance, develop standards for forest practice alternative plans, and administer a Forestry Riparian Easement Program (FREP). FREP is a compensation program intended to partially compensate qualifying small forest landowners for leaving forest and fish riparian management zones in exchange for a fifty-year easement. The purpose of the program is to provide an incentive to small forest landowners to keep their lands in forest use.

In 1998, the U.S. Forest Service's Cle Elum Ranger District embarked on a new program entitled "Respect the River". It has become an annual program which balances the need for restoration and preservation of riparian areas, with the strong desires of the public to recreate near streams and lakes. Increasing public use on these areas is contributing to increased soil damage and a loss of streambank vegetation. The program provides the district the ability to identify and correct water quality problems with restoration projects, aimed at managing and restoring riparian vegetation, reducing streambank soil erosion, and improving floodplain water storage. In addition, it functions as an umbrella program to conduct a variety of riparian educational projects with local agencies, clubs, businesses and educational institutions, emphasizing prevention of riparian damage through responsible recreation practices. Restoration work began in the Teanaway watershed in 1999 and will continue as funding permits.

To improve instream flows and fish passage in the Teanaway River subbasin, the USBR, the NRCS, and others have supported the conversion of three gravity-flow irrigation diversions and associated open, unlined earthen ditches and laterals to modern pump and pipeline irrigation systems. Thirty percent of the water conserved as a result of these three water conservation systems has been transferred from its original irrigation use to instream flow use by order of the Yakima Adjudication Court (March 9, 2000 Order Pendente Lite). Once the adjudication is completed, this conserved water will be permanently transferred to instream flow use under the State Trust Water Rights Program.

In addition, the points of diversion were re-located to downstream pumpsites, allowing all of the water (approximately 13 cfs) to remain in the Teanaway River for an additional three miles. Funding for these water conservation systems has been provided by the Northwest Power Planning Council's Fish and Wildlife Program, which is funded by the Bonneville Power Administration (BPA).

The USBR also has been working with landowners in the Teanaway Basin who are interested in selling conservation easements, land, and/or water rights, which could provide additional riparian shade and instream flow. Funding is provided by the Yakima River Basin Water Enhancement Project (YRBWEP), Public Law 103-434.

Reclamation has purchased a former water right from the Teanaway River and obtained authorization from the Yakima Adjudication Court (March 9, 2000 Order Pendente Lite) to assign these former irrigation water rights to instream flow enhancement use in the Teanaway River and downstream in the Yakima River all the way to the Columbia River. The water rights total 0.4 cfs, 108 acre-feet per year of water formerly used for irrigation of 20 acres. The entire amount of these water rights is now assigned to instream flow use at the water rights' original points of diversion. The consumptive use portion of these water rights, 0.11 cfs, 30 acre-feet per year, is protected as an increased instream flow downstream all the way to the Yakima River's confluence with the Columbia River. Upon completion of the Yakima River Adjudication, these water rights will be permanently assigned to the State Trust Water Rights Program as instream flow enhancement trust water rights. Reclamation purchased this privately owned property and water rights with funds authorized for water and land acquisition under the Yakima River Basin Water Enhancement Program (YRBWEP), Public Law 103-434.

Ecology staff will continue to identify funding sources, like the Water Resources Program's water rights acquisition funding, to use to acquire available water rights from willing sellers through negotiated purchase agreements. Purchased water will be assigned to instream flow enhancement use in the Teanaway and Yakima Rivers.

The conservation work in the Teanaway River has already benefited spring chinook salmon and other fish that utilize the Teanaway River subbasin. Improving irrigation water use efficiency, eliminating several in-river irrigation diversion berms, leasing and purchasing several Teanaway River water rights, and assigning the conserved/leased/and purchased water to instream flow enhancement use, have substantially improved instream flows and provided upstream passage for salmonids. The result is greatly increased numbers of spring chinook salmon now using the Teanaway River for spawning and rearing habitat. On average, from 1980 through 1999, Yakama Nation fish biologists counted only one spring chinook redd (or nest) in the Teanaway River subbasin. In 2000, biologists counted 27 spring chinook redds in the Teanaway River. Prospects for 2001 are equally as good, with early indications of a similarly strong return of adult spring chinook salmon to the Yakima River system

Under the Watershed Planning Act (RCW 90.82), the Yakima River Basin Watershed Planning Unit also is assessing water supply and use in the basin, and is developing strategies for future use. It also is evaluating flows needed for fish habitat. Therefore, instream flows will be evaluated further, as required in the implementation of the TMDL.

The NRCS, Ecology and other agencies also have provided and continue to provide educational and technical services to individual and groups in the area.

A proposed study and development of a sediment budget including bedload and suspended sediment and the relationship of sediment to channel morphology, width-to-depth ratio, active channel zone and temperature will be described in the Detailed Implementation Plan.

Supporting Regulations and Land Management Plans

U.S. Forest Service (USFS) lands

Ecology and the USFS Region 6 have signed a Memorandum of Agreement (MOA) (Nov 21, 2000) addressing protection of water quality on federal forested lands in Washington State. Under this agreement, the USFS "will ensure that all waters on NFS lands meet or exceed water quality laws and regulations and that activities on those lands are consistent with the level of protection of the Washington Administrative Code (WAC) relevant to state and federal water quality requirements." The MOA also states that "Activities on National Forests are expected to meet or exceed the requirements that apply to non-federal lands…"

The USFS has agreed to restore impaired water bodies within its jurisdiction to conditions that meet or surpass standards designated for beneficial uses. This includes meeting or exceeding state water quality laws and regulations, as contained in the state Forest Practices Rules WAC 222. This includes proactive actions regarding road stabilization and maintenance, and maintenance of riparian buffers.

The Okanogan – Wenatchee National Forest Management Plan identifies an Aquatic Conservation Strategy which was developed to restore and maintain the ecological health of watersheds, and aquatic ecosystems contained within them, on public lands. Two key components are 1) the land allocation of Riparian Reserves, which have special standards and guidelines developed for their protection and restoration, and 2) watershed restoration.

The U.S. Forest Service will complete road analysis for all roads for which the agency has authority so as to identify a maintenance level for each road segment and any corrective measures needed to resolve water quality issues identified through the road analysis process. This planning action will be accomplished with public input and input from other federal and state management agencies. Specific corrective actions will be taken following completion of the NEPA process. Trailhead restoration needs will be included in the road analysis and restoration planing. Impacts to streams and floodplains from developed and dispersed recreation use will be evaluated as part of recreation planning efforts.

Ecology staff will review USFS planning and implementation activities to ensure that state water quality laws and regulations are being met or exceeded. This includes the responsibility to

certify that general water quality Best Management Practices (BMPs) and current Forest Plans are consistent with the CWA. The certification process includes the comparison of state BMPs and USFS BMPs. If Ecology or the USFS determines that USFS BMPs provide less resource protection than state BMPs, the USFS will review the BMPs for amendment.

Private and state-owned forested lands

In 1999, various state and federal agencies, counties, some tribes and the timber industry negotiated the Forests and Fish Report (F&F) to address impacts caused by forest harvesting activities on water quality and fish and six riparian-dependent amphibians. This agreement was contingent on the state adopting improved forest practice regulations as well as funding and implementing a monitoring program to demonstrate the effectiveness of the new rules in protecting water quality and fisheries habitat. Landowners also agreed to share water quality information with the other parties to the agreement.

Emergency forest practice regulations were adopted by the Washington Forest Practices Board and became effective March 20, 2000. These rules are representative of the F&F agreement. Permanent rules have now been adopted.

Negotiated "assurances" were provided to the timber industry under the agreement for supporting improved forest practice regulations. These assurances include 1) development of TMDLs for 303(d) listed waterbodies impacted primarily or solely by forest practices may be delayed to the year 2009, 2) EPA and Ecology would not ask the Forest Practices Board to adopt any more stringent rules except through the adaptive management program set out in F&F, and 3) the F&F adaptive management process will be used to adjust forest practices, if necessary, to meet load allocations of TMDLs produced for streams in mixed use watersheds.

Initial development of this TMDL predates F&F and the allocations are necessary to address all the causes of temperature problems in the Teanaway River basin. Load allocations are included in this TMDL for forest lands in the Teanaway Basin in accordance with the section of F&F entitled "TMDLs produced prior to 2009 in mixed use watersheds". Also consistent with the F&F agreement, implementation of the load allocations established in this TMDL for private and state forestlands will be accomplished via implementation of the revised forest practice regulations. The effectiveness of the Forests and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If shade is not moving on a path toward the TMDL load allocation by 2009, Ecology will suggest changes to the Forest Practices Board.

F&F assurances are provided for forest harvesting activities conducted under regulations adopted pursuant to F&F; the 20 acres exempt rule is not covered. Since the Teanaway TMDL analysis concludes that all stream segments downstream of site four are shade deficient, existing shade should not be further reduced in the riparian buffers. Accordingly, forest practices conducted under the 20-acre exempt rule are expected to comply with the allocations for stream shade established in this TMDL. Therefore, Washington State Department of Natural Resources (DNR) is encouraged to condition forest practices to prohibit any further reduction of stream shade and not waive or modify any shade requirements for timber harvesting activities on state

and private lands. Ecology is committed in assisting DNR in identifying those site-specific situations where reduction of shade has the potential for or could cause material damage to public resources.

New emergency rules for roads also apply. These include new road construction standards, as well as new standards and a schedule for upgrading existing roads. Under the new rules, roads must provide for better control of road-related sediments; provide better streambank stability protection; and meet current Best Management Practices. DNR is also responsible for oversight on these activities.

Riparian habitat areas, on non-federal lands

The Kittitas County Critical Areas Ordinance (CAO) (Title 17A) applies to lands within unincorporated Kittitas County, including both State and privately owned lands. In the Teanaway basin this applies to all non-federal lands. Land use activities subject to these ordinances are generally those that require a County permit. The activities include building permits; rezones or platting; shoreline substantial development or conditional use permits or variances; and any activity that is not exempt from a threshold determination under the state Environmental Policy Act. Exempt land use activities include existing and ongoing agricultural and irrigation activities; and forest practices conducted in accordance with the provisions WAC 222.

Section 17A.07.010 of the county ordinance, which sets standards for riparian habitat, is the most directly applicable. It establishes buffer widths based on a water typing system. The Teanaway mainstem and its three principal tributaries (the West, Middle and North Forks) up to the USFS boundary are Type I waters. For these waters, the buffer zone is 40-200 feet from the Ordinary High Water Mark (OHWM). The presence of threatened, endangered or sensitive species or anadromous fish is to be considered in establishing the buffer width. Under the CAO, "Riparian habitat buffer areas shall be retained in their natural condition or may be improved to enhance buffer functions and values."

Shorelands within 200 feet of rivers, on non-federal lands

Under the Shoreline Management Act (SMA), local governments have the primary responsibility for initiating the planning programs and administering the regulatory requirements in support of the Act, with Ecology serving in a supportive and review capacity. Kittitas County and Ecology share the responsibility for permit review and enforcement, as described in Chapter 173-27 WAC. Kittitas County procedures are described in its Master Program regulations (County Shoreline Regulations, Sections 38-46). Under SMA, “shorelands” include lands 200 feet landward from the edge of designated waters (RCW 90.58.030).

Kittitas County finalized its Shoreline Master Program (Master Program) in March of 1975. The County shoreline regulations are found in its Master Program, Chapter Six (County Shoreline Regulations).

Under the county Master Program, the shorelands of the Teanaway River and its three main tributaries up to the USFS boundary have been designated as either rural or conservancy. Under

these regulations, all structures shall be set back from the rivers a minimum of 100 feet (County Shoreline Regulations, Section 14). The county regulations allow all agricultural activities in shoreline areas designated Rural. They also allow agricultural activities in shoreline areas designated Conservancy, provided that its operations do not substantially change the character of the environment. (County Shoreline Regulations, Section 20). And under certain circumstances the county provides variances for some structures to be built within 100 feet of the shoreline. (County Shoreline Regulations, Section 40). County regulations also state that whether or not a proposed development within the jurisdictional boundaries of the Act requires a permit, the development must be consistent with the intent of the law and the regulations of the Kittitas County Master Program and SMA.

Under the county permit system, a permit must be obtained for any "substantial development" proposed on a designated shoreline, with seven general exceptions. Substantial development is defined as being any development of which the fair market value exceeds $2,500 or any development that would interfere with the normal public use of the water or shorelines. One of the exemptions is for construction of barns or similar agricultural buildings. Another is for single-family dwellings for use by the owner or his family and not to exceed a height of 35 feet.

The county xhoreline regulations require the following: (1) All construction be designed to protect the adjacent shoreline lands against erosion, uncontrolled drainage, slides, pollution, excessive excavations and fills and other factors detrimental to the environment. Shoreline development shall not substantially diminish the natural quality or near natural quality of nearby areas, including the quality of the water involved. (2) Buffer strips of permanent vegetation between shoreline developments and associated water bodies are encouraged, and private and public landowners shall be responsible for the preservation of vegetation to minimize erosion within the shoreline area. (3) Upon completion of installation of any substantial development that disturbs the environment, the disturbed area shall be regraded to compatibility with the natural terrain and replanted to provide an attractive vegetation cover that is harmonious with the surrounding area and project requirements. (County Shoreline Regulations, Section 19.) The county has been incorporating the minimal requirements of the Critical Areas Ordinance (40-foot buffer of native vegetation) in this requirement.

Under Kittitas County's shoreline permit system, administrative responsibility for shorelines within the unincorporated portions of the County lies with the Kittitas County Planning Department.

Water use laws and regulations

The Washington Water Code is based on the doctrine of prior appropriation. In times of water shortages, the junior water rights are partially or fully shut off to enable holders of senior rights to fully use the water to which they are entitled. The Teanaway basin has recently been adjudicated; therefore, no additional water rights will be granted. Metering systems are being installed and checked on a regular basis to ensure non-exceedence of existing water rights.

All listed waters in the basin

State water quality laws and regulations also support implementation of this TMDL. The state water pollution control law (RCW 90.48.010) states that, "It is declared to be the policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wildlife, birds, game, fish and other aquatic life…" Pollution is defined to specifically include alteration of any waters of the state, including change in temperature and sediment. State law and regulations (RCW 90.48.142; WAC 173-201A-160(2)) provide for issuing penalties for actions that cause death or injury to fish, animals, vegetation, or other resources of the state. It is intended that these regulations serve to back up other, more local authorities.

Reasonable Assurance

See Supporting Regulations and Land Management plans above.

Full recovery of stream temperatures depends on the restoration of shade and stream corridors to near natural conditions. This plan is based in large measure on existing laws, regulations and the voluntary actions of property owners with lands adjacent to streams, to protect and restore riparian areas. Local residents, the Kittitas County Conservation District, NRCS, and the USBR are already implementing riparian restoration activities and conservation measures. Recent activities by local landowners on private riparian lands have included planting trees along stream banks (5,300 were planted this last year), barbs to reduce bank erosion, and water conservation programs to increase instream flows. The DNR and private forest landowners are actively involved in implementing the Forests and Fish Rules and the USFS is implementing road and trail improvements along with Water Quality Restoration Planning to address temperature issues on their lands.

A local resident workgroup has formed of landowners and others who have a strong interest and history of caring for the river. This group has recommended, as a priority, performing an assessment of current and past activities and conditions to establish baseline data and information to evaluate future implementation on. Funding sources and technical support exist and additional resources will be sought to support these activities. Government requests for funding from other sources concerning programs and actions to reduce instream temperatures will be shared with the Teanaway property owners in an effort to gain the maximum possible consensus to the best and most economical solutions. In addition, existing rules, ordinances, and agreements address the protection of riparian buffer zones and sediment effects over the area covered by this TMDL. The proposed monitoring will track progress and identify whether additional measures are needed.

Adaptive Management

A Detailed Implementation Plan will be developed that will include a monitoring plan to evaluate implementation measures. If planned implementation activities are not producing expected or required results, Ecology or other entities may choose to do additional studies to identify the significant sources of heat input to the river system. If the causes can be determined, additional implementation measures may be needed. For non-federal forested areas, the agreements in the Forests and Fish Report incorporate adaptive management as needed to meet the allocations in this report. The USFS also has a policy of adaptive management. Re-evaluation is anticipated to occur at five to ten-year intervals. The TMDL may be modified as a result.

Monitoring procedures will be used to evaluate progress toward attainment of the water quality standards. Milestones will be developed as part of the Detailed Implementation Plan (DIP). If it appears progress is not being made, both the implementation measures and the need for additional studies will be re-evaluated. Additional studies may also be identified as needed to evaluate existing conditions or implementation activities.

Monitoring Strategy

Monitoring is included as part of the implementation strategy. It serves to track and evaluate the effectiveness of implementation measures. Five general monitoring procedures, to be implemented concurrently, are described below. Baseline inventories of riparian vegetation and channel conditions will be established. More information will be provided in the Detailed Implementation Plan (DIP).

Procedure 1: Track stream temperature

Stream temperature will be monitored for attainment of standards and the results evaluated at 5 to ten-year intervals, or consistent with timelines established within the Forests and Fish Rules. This will be determined with the development of the Detailed Implementation Plan. This is expected to continue for decades, and results may not be observed for a decade or more.

In addition, the relationship between stream temperature and air temperature will be used to track progress. The regression of water temperature against air temperature will be plotted over time to determine whether water temperatures are cooler for specific air temperatures. If stream temperature does not decrease relative to the air temperature, a reassessment of modeling parameters and/or adaptive management may be needed.

Procedure 2: Monitor for attainment of site potential shade (includes sediment) and maintenance of flow

Parameters that may be monitored include shade, active channel zone widths, width to depth ratio, sediment (bedload, suspended sediment, turbidity), temperature, and flow. Baselines will be established and surveys conducted in at least five to ten-year intervals. Aerial photos may be used to determine completeness over all reaches of concern. Studies of sediment loading and impacts on stream morphology also are proposed.

Procedure 3: Track implementation

Implementation of voluntary riparian restoration activities and instream flow restoration will be tracked, as well as implementation of existing regulations. If it is determined that these are not adequate or not being fully implemented, other voluntary or alternative methods of implementation may be needed.

Procedure 4: Track temperature-dependent biota and other parameters as appropriate

The health of macroinvertebrate and salmonid populations and/or other indicators may be used to track recovery of the riparian and river systems. The presence of a healthy aquatic ecosystem typical of this type of stream will be a useful indicator of success of this project.

Potential Funding Sources

Potential funding sources include grants and loans offered through the Centennial Clean Water Fund. Additionally, there are other sources of funding available for salmon habitat, salmon restoration efforts and associated projects that support the riparian shade and instream flow needs of this TMDL.

Public Participation

Public involvement is a required part of the TMDL process. The following describes public participation activities performed to date for this TMDL. Additional public involvement activities will include participation in preparation of the Detailed Implementation Plan (DIP).

The Environmental Assessment Program (EAP) staff of Ecology began a pilot temperature study in the Teanaway, with data collected during the summer season of 1998. Data was evaluated over the winter and spring of 1999, when it was recognized that the work could be the basis for the technical portion of a TMDL.

Beginning in August of 1999, Ecology began contacting technical staff from federal, state and local agencies, interest groups, landowners, and the Yakama Nation to inform them of the project, and to identify their interest in participating in a technical workgroup. Public involvement activities included eighteen meetings with individuals and small groups to identify potential concerns; four formal presentations with question and answer sessions; a tour of the Teanaway River basin; plus numerous phone calls and e-mail exchanges. The workgroup included mostly representatives from government agencies with some attendance by local residents.

The first workgroup meeting was held in April 2000, timed to correspond to the release of the "Teanaway River Basin Temperature Pilot Technical Assessment". Workgroup meetings were held approximately once a month through December 2000. Additional informal meetings, telephone conversations, letters and e-mail exchanges occurred, plus general educational information provided at workshops and fairs as part of outreach efforts. Supplemental public involvement activities also included a full-day training in Proper Functioning Condition (PFC); a press release (resulting in a news article in the "Northern Kittitas County Tribune" on the availability of Washington Conservation Corps (WCC) crews and riparian vegetation; and publications to the Carpenter Memorial Library in Cle Elum. The technical assessment and the Draft Summary Implementation Strategy (SIS) were reviewed at workgroup meetings.

The draft TMDL submittal report was presented to the workgroup and at two public workshops. Notices were published in the two local newspapers, the Northern Kittitas County Tribune (Cle Elum) and the Ellensburg Daily Record announcing the availability of the draft TMDL report and the opening of a 30-day public comment period. Responses to written comments have been incorporated in Appendix C (Responsiveness Summary) of the final report. Ecology will continue to work with the advisory group to prepare the DIP.

Definitions and Acronyms

Definitions

Active channel zone – water surface plus adjacent channel bed, and unvegetated bars and/or terraces

Mature riparian forest – a group of trees adjacent to a waterbody that has reached full natural growth or development.

Mature riparian vegetation – appropriate native plants, adjacent to a waterbody, that have reached full natural growth or development; where possible, mature riparian vegetation equals or includes a mature riparian forest.

Natural conditions – 1. conditions prior to human influence, 2. " 'natural conditions' or 'natural background levels' means surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed it may be necessary to use the less disturbed conditions of a neighboring or similar watershed as a reference condition." [Washington water quality regulations, WAC 173-201A]

Natural processes – those actions, operations, and cycles that occur in the natural environment without the intervention or aid of man.

Near-natural conditions – surface water quality that is as similar to "natural conditions" (see above definition) as can reasonably be achieved in an area inhabited by humans.

Riparian zone – 1. the land area and associated vegetation bordering the bank of a river or other body of water; 2. a transition zone between dry land and water communities; 3. the zone of direct interaction between terrestrial and stream systems.

Site potential shade – generally, the shade that is achievable with a "mature riparian forest"; however, in areas where trees cannot grow in the riparian zone, site potential shade may be provided by "mature riparian vegetation" or natural landforms such as rock walls, ledges, etc.

Site potential size trees – trees that are appropriate for a given site and that have reached full natural growth or development.

Surrogate - substitute; allowed, per EPA regulations (40 CFR §130.2(i))

Acronyms

BMPs – Best Management Practices
BPA – Bonneville Power Administration
CAO – County's Critical Areas Ordinance
CCWF - Centennial Clean Water Fund
cfs – cubic feet per second
CREP – Conservation Reserve Enhancement Program
CWA – Federal Clean Water Act
DIP – Detailed Implementation Plan
DNR – Washington Department of Natural Resources
EAP – Ecology's Environmental Assessment Program
EPA – US Environmental Protection Agency
EQIP – NRCS's Environmental Quality Incentive Program
F&F – Forests & Fish Agreement
FREP – Forestry Riparian Easement Program
LSO – Land Survey Office
MOA – Memorandum of Agreement
NRCS – Natural Resources Conservation Service
OHWM – Ordinary High Water Mark
PFC - proper functioning condition
RCW – Revised Code of Washington
SIS – Summary Implementation Strategy
SMA – Shorelines Management Act (RCW 90.58)
SRF – State Water Pollution Control Revolving Fund
SSTEMP – Stream Segment Temperature Model
TFW - Timber, Fish and Wildlife
TMDL - total maximum daily load
USBR – U.S. Bureau of Reclamation
USFS – U.S.D.A. Forest Service
USGS – U.S. Geological Survey
WAC – Washington Administrative Code
WCC – Washington Conservation Corps
WDFW – Washington Department of Fish & Wildlife
WQ – Water Quality
YRBWEP – Yakima River Basin Water Enhancement Project

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Appendix A

Teanaway River Basin Temperature Pilot Technical Assessment

By Anita Stohr
April 2000
Washington State Department of Ecology
Environmental Assessment Program

(Available in hard copy on request or see the web site for the publication number below)

http://www.ecy.wa.gov/biblio/0003015.html

Ecology Publication No. 00-03-015

Appendix B

Summary Implementation Strategy

Appendix B

Implementation Information

Summary Implementation Strategy – LAND OWNERS and LAND MANAGERS

Landowner/ Group/ Operator	"Issues"	Existing Implementation	Potential Further Action	Support Provided/Needed	Time Line
USFS	Forest Management and Recreation	Road survey complete Memorandum of Agreement (MOA) with Ecology, Respect the River Program	USFS identify/commit to specific road removal and riparian restoration actions Restore trailheads and recreational sites adjacent to streams Monitoring	Workgroup to help identify priority roads and riparian areas; Congressional funding; CWA grants	Identify and publish in Federal Register in 2001; implement in 2002, Road analysis complete 2002
US Timberlands	Forest Management and Recreation	Forest Practices Act; Forests and Fish rules. Road improvements	BMP Implementation Monitoring	Voluntary activities Evaluation monitoring?	On-going
Plum Creek	Forest Management	Forest Practices Act; Forests and Fish rules.	BMP Implementation Monitoring	Voluntary activities Evaluation monitoring?	On-going
DNR	Forest Management	Forest and Fish rules	Technical Assistance	Evaluation monitoring	On-going
Ranchers	Grazing	Right to Farm Ordinances Implement BMPs	Additional best management practices Education & Outreach	WCC crews provide riparian restoration, grazing management support.	On-going
Farm Forestry	Forest Management	Forest and Fish rules;	Education & Outreach	WCC crews provide riparian restoration.	On-going
Farmers	Agricultural - riparian - irrigation	Critical Area Ordinances (CAO) Right to Farm Ordinances Implement BMPs Lease water, change points of withdrawal, sprinkler conversion.	Voluntary implement BMPs Education & Outreach Possible: additional sprinkler conversion, sell unused water rights	WCC crews provide riparian restoration; Technical assistance by NRCS, KCCD, WDOE; Funding still available from USBR/BPA/DOE	Apply for funding from NRCS now and from WDOE Feb 2002
Homeowners	Homes - riparian - floodplain	Critical Area Ordinances (CAO)	Voluntary implement BMPs Obtain funding to map floodplains.	WCC crews provide riparian restoration. County and NRCS to provide information regarding riparian,	On-going

Summary Implementation Strategy – AGENCIES and ORGANIZATIONS

Landowner/ Group/ Operator	"Issues"	Existing Implementation	Potential Further Action	Support Needs	Time Line
Teanaway local resident Workgroup	All	Review proposed actions for TMDL	Complete Detailed Implementation Plan. Prioritize implementation activities		Oct. 2002
U.S. Bureau of Reclamation (USBR)	Agricultural - irrigation water supply	Water leases and purchases; change points of withdrawal to downstream.	Provide continued funding for water conservation	Voluntary local support	On-going
WA Department of Natural Resources (DNR)	Forest Management Forest Practices`	Technical assistance 5 year review of existing watershed analyses Small Forest Landowner programs; Stewardship programs	Evaluation monitoring		On-going
Natural Resources Conservation Service (NRCS) and Kittitas County Conservation District (KCCD)	Agricultural - riparian	Technical assistance; includes riparian restoration, farm plans, sprinkler conversion projects. Funding: EQIP, CREP Guidance: Riparian Forest Buffer, FOTG 391A-1	Additional funding opportunities Evaluation monitoring	Voluntary local support Technical assistance	On-going
NRCS	Grazing	Technical Assistance Guidance: BMP implementation	Funds; Small Ranch manual	Technical assistance	On-going
NRCS	Homes	BMP implementation	Rural Living Handbook	Technical assistance	On-going
DNR	Erosion of earthen roads can cause sediment release to adjacent tributaries Recreational use of riparian areas can cause bank erosion	Compliance with Forest Practices Act and with Forests and Fish rules	Manage state Forest lands	Resources to continue road maintenance and forest management	On-going
Kittitas County Planning Dept.	Homes Riparian	County riparian and floodplain critical area ordinances (CAOs). Shoreline master plan. Education and outreach Public information on riparian and floodplain areas.	BMP implementation Funding	Volunteer support; funding for floodplain mapping	On-going
Kittitas County Public Works, Road Maintenance	Roads	BMP implementation Road improvements	Sediment assessment	Funding	On-going

Summary Implementation Strategy – AGENCIES and ORGANIZATIONS

Landowner/ Group/ Operator	"Issues"	Existing Implementation	Potential Further Action	Support Needs	Time Line
WA Dept of Ecology	Water quality; streams and riparian areas	WCC crews for riparian restoration; TMDL; RCW 90.48; Shorelines Management Act	Technical assistance; assist funding for floodplain mapping; additional funding?	Input from Workgroup!	Through June 2001
Audubon Society	Riparian areas	Participate in workgroup activities	Provide Technical assistance Education and Outreach	Funding	On-going
Kittitas County Water Purveyors (KCWP)	Agricultural - irrigation water supply (outside the valley)	Technical assistance, newsletter, Right to Farm Ordinances BMP implementation	BMP implementation	Funding	On-going
WA Dept of Fish & Wildlife	Fish and Wildlife habitat	Technical assistance on riparian restoration; HPAs for instream construction	Continued technical assistance	Funding Technical assistance	On-going
WA Dept. of Transportation (WDOT)	Roads and bridges	BMP implementation	Monitoring evaluations Road Maintenance	Funding Technical assistance	On-going
US National Marine Fisheries Service (NMFS)	Steelhead habitat	ESA (Section 7 on federal lands. Section 10 or 4(d) on state and private lands.)	Continue current activities	Funding	On-going
US Fish and Wildlife Service (USFWS)	Bull trout habitat	ESA (Section 7 on federal lands. Section 10 or 4(d) on state and private lands.)	Continue current activities	Evaluation monitoring Funding	On-going
US Environmental Protection Agency (USEPA)	Water quality	Clean Water Act; grants available Directs Ecology	Continue current activities	Funding	On-going
Yakama Nation	Fisheries, especially Chinook	BPA funding for fisheries studies; provide technical assistance with respect to riparian restoration – technical assistance as requested	Support obtaining funds, if requested. Technical assistance.	Workgroup identify needs	On-going

Appendix C

Public Participation

List of Meetings/Workshops

Focus Sheets/News Articles

Affidavits of Publication

Mailing List

Comment Letters and Summary of Responses for TMDL Report

Comment letter and Response for Pilot Technical Assessment

Summary of Responses to Comments

TO DRAFT TMDL REPORT: **"Teanaway Temperature Total Maximum Daily Load Submittal Report", Draft, May 2001, Publication No. 01-10-019**

We received many comments from several of you and have enclosed them in this appendix. We have taken many similar comments and grouped them by paraphrasing while capturing the ideas from all the comments and then providing a general response. Many comments were incorporated into the actual document and the rest have either been noted or addressed individually.

There were several comments about open range with livestock grazing riparian areas and being allowed to wander in the river and concerns about fecal coliform pollution.

Response: This TMDL is for temperature, rather than fecal pollution. There are riparian water rights for livestock in this state which allow livestock to have direct access to waters of the state and the Teanaway basin is considered open Range. There are practices that can be implemented to reduce the impact of open range livestock on water quality. This is an issue that deserves further discussion among landowners, livestock owners, the Conservation District, and county and state government.

Comments were also received about equipment being allowed in the river and dumping oil around waters.

Response: There are procedures and permits that are required when working in or around waters of the state. Details of actions to address impacts on riparian vegetation will be discussed during development of the Detailed Implementation Plan.*)*

Dumping of oils or any other pollutants into waters of the state is a violation of state water quality law (RCW 90.48). Such actions should be reported to the nearest Washington State Department of Ecology, 24 hours, on the emergency response hotline. The number for the Yakima office is (509) 575-2490.

Many comments were received about logging with concerns about cumulative effects, sediment load and who will monitor water quality to determine the impact from the current practices.

Response: New forest practices rules have recently been adopted in the state of Washington in connection with the Forests and Fish report (see draft TMDL, page 17). The rules are designed to meet the state water quality standards.

The rules rely on best management practices, but they also are performance-based. If implementation of the rules does not achieve compliance with water quality standards, additional requirements will be developed through the adaptive management process.

Ecology has committed not to apply additional requirements until 2009, except through the adaptive management process. A study of sediment is proposed to provide information to be used in the adaptive management process (draft TMDL, page 21). It

has been proposed to consider additional studies that would address cumulative effects on basin hydrology (draft TMDL, page 24). The possibility of additional studies will be discussed during the development of the Detailed Implementation Plan.

Ecology proposes to work with the workgroup and other entities to develop a monitoring plan. Details will be worked out during development of the Detailed Implementation Plan.

Many comments received were about the lack of historical data and the need for more studies and data collection to quantify conditions prior to making recommendations. Also of concern were those natural causes for the loss of shade channel width and depth, snow, rain, runoff, and ambient air temperatures. It was also commented that it has not been proven that human impacts are responsible for stream temperature increases. Other comments pointed out that all factors affecting stream temperature need to be assessed cumulatively. Individual, isolated evaluation of factors may miss cumulative and synergistic effects.

Response: Studies to identify and evaluate the impact of natural thermal conditions may be proposed during development of the Detailed Implementation Plan. Natural conditions, such as drought, are incorporated implicitly in the assessment.

Over ten years of data show that stream temperatures in the Teanaway regularly exceed state numeric criteria. USFS data collected in 1990 and 1992 through 2000 show that stream temperatures exceeded state numeric criteria every year on the three main tributaries (the North, Middle and West forks) of the Teanaway and on Stafford Creek. (With one exception: Stafford Creek in 1993.) Data collected under the Yakama Nation TFW program show similar elevated temperatures. Data collected on the three main tributaries to the Teanaway in 1992, 1993 and 1995, show that stream temperatures exceeded the state numeric water quality criteria up to 57 days of the summer. Data collected by the Ecology during the summer of 1998 (July 1 through October 6) show that at seven of the sites monitored, stream temperatures exceeded the state numeric criteria from 31 to 93 percent of the days.

Stream temperatures reflect a wide range of effects, many of them from natural sources; e.g., air temperature, wind speed, amount of snowmelt or rainfall.

Stream temperatures also reflect human effects. It is difficult, if not impossible; to look at stream temperatures and determine what part of the temperature is caused by natural conditions and what part by human actions. A special evaluation is necessary to separate the effects of human actions from those of natural factors. It is Ecology's judgement that the technical study has adequately demonstrated that impacts on shade, stream width to depth ratio, and flow can increase stream temperatures and contribute to the streams' continued exceedance of state standards. See the technical assessment.

Additional studies may be performed as needed to identify and quantify other potentially significant effects on basin conditions. These include cumulative effects on basin hydrology and effects of future growth in the basin (draft TMDL report, page 21). Further

tracking of stream temperature is proposed in this TMDL, with various methods to identify improvements caused by changes in human actions as distinguished from natural effects. Details of these studies will be worked out during development of the Detailed Implementation Plan.

Some comments were received about how to get the trees or riparian vegetation to live long enough to provide shade and protect the banks from erosion. Difficulty getting trees, brush and grass to grow on rocky banks. It was commented that the problem is not minor and this will be a lengthy process and will take time to see results of shade.

Response: Local experience and expertise will be used to identify the most effective methods, which may include use of barbs for bank stabilization, temporary irrigation, etc. Details will be worked out by the workgroup during development of the Detailed Implementation Plan.

Ecology strongly agrees about the time involved. In the draft TMDL report it was proposed to monitor stream temperatures at 5 to10-year intervals, over decades. Results might not be observed for a decade or more. (Draft TMDL report, page 21)

Comments were also received about the availability of historical flood data and maps to show flood activity over the years. It was also noted that appropriate measures and guidelines should be drawn up with landowner input for protecting their property and the river. Also comments about controlling floodwaters with small dams to equalize flows and protect riparian vegetation to maintain shade was made.

Response: In the technical assessment, general information about natural conditions was used for potential tree heights, the potential width to depth ratio, and summer low flows. (See the technical assessment for details.) In the draft TMDL report (page 10), it is noted that high flow events might counter the establishment of a mature riparian forest. However, a healthy riparian zone can provide additional bank stability, slow the movement and associated disruptive force of flood waters, and decrease the magnitude of downstream flood peaks. As the health of a watershed improves, the destructive power of floods should decrease.

Flood data will be used during development of the Detailed Implementation Plan to evaluate the effects of floods on site-potential tree height and active channel zone width at specific locations.

Further studies and field investigations can help refine where flooding is likely to have its greatest negative effect on trees and what activities can be used most beneficially to slow down flood waters, increase infiltration, and reduce downstream flooding. Appropriate studies and measures to address flooding and erosion will be discussed during development of the Detailed Implementation Plan.

If future studies or the additional site-specific information collected during implementation indicate that the values used in the study (e.g., for potential trees height,

potential width to depth ratio) should be modified, this will be done, and the associated predicted stream temperatures re-calculated.

Ecology supports local efforts and is eager to work with landowners (and the County) to identify appropriate means to help protect property and the river.

A comment was received that no research was done on soil types, erosion and grade of river.

Response: River grade was measured, and used in the model. Further research on erosion is proposed in the TMDL submittal report. Information about soil types can be collected and incorporated into future research, as appropriate. Details can be worked out during development of the Detailed Implementation Plan.

A comment in the form of a question about whether the TMDL being only for water temperature and would not affect instream flows was asked. The report failed to address other impacts on flows such as transpiration and evaporation. It was also commented that the report needed an allocation for increased flow in the river.

Response: The model used in the technical assessment shows that increasing stream flow can decrease stream temperature.

The TMDL does not require an increase in stream flow. The actions proposed are to use existing laws and voluntary actions. Existing laws include protection and enforcement of existing water rights. Voluntary actions include conservation, and voluntary sale, lease or transfer of water rights.

The draft TMDL report states (page 9): "Effects of reduced flow were evaluated in general terms, but, because of the complexity of the hydrologic system in the lower valley, further studies would be needed to better quantify these impacts. Such studies should address multiple surface water intakes, groundwater withdrawals, surface and subsurface return flows, and evapotranspiration." Studies to address transpiration and evaporation may be proposed during development of the Detailed Implementation Plan.

It was commented that there needed to be an allocation for increased channel width related to sediment loading. Ecology was urged to make load allocations for flow, sediment and shade in this TMDL.

Response: The allocation for increased channel width is incorporated in the allocation for shade (see Tables 3 and 4, second values in the fourth and next-to-last columns). The width of the channel helps determine the effectiveness of the shade provided the stream. Future studies on sediment loading will be looked at during implementation.

More specific and measurable actions and associated time frames will be provided in the Detailed Implementation Plan.

A comment was made that the computer modeling, which suggests that the imposition of all possible corrective measures will not satisfy the required temperature criteria, has been

suppressed and the original goal of creating a prime salmon habitat has been replaced by the lesser concept of simply pursuing movement in the right direction.

Response: Ecology is not aware of any computer modeling results that have been suppressed.

Ecology concurs that there may be cases where the imposition of all possible (i.e., reasonable) corrective measures will not satisfy the temperature criteria. In the TMDL submittal report, only the implementation of reasonable measures is recommended.

This TMDL is for stream temperature, with a goal of meeting state water quality standards. This will provide an improved habitat for coldwater species. However, the TMDL does not have (and has not had) the explicit goal of providing prime salmon habitat.

There were several comments made about dissatisfaction with the process and public involvement in developing the technical assessment and submittal.

Response: Ecology acknowledges that the process of involving and listening to workgroup members should have been better. Additional time was given to get more input from the workgroup on the submittal report and Ecology looks forward to the workgroup and local involvement in developing the implementation plan. This will be your plan to develop as a workgroup and the willingness of local landowners to implement viable practices to improve water temperature is very encouraging.

Ecology has attempted to include a wide variety of interest groups, organizations, local government, and local participation in the process. Over 50 entities were contacted. Many different ideas have been advanced over the course of the public involvement process, not always at the workgroup meetings, and not always concurring with each other. Because it has not been possible for all members to attend all workgroup meetings and because Ecology is ultimately responsible for defending the contents of the TMDL submittal report, Ecology has made the final, difficult decisions on some issues.

Examples of suggestions provided by workgroup members that were incorporated into the draft TMDL submittal report:

- Possible use of mechanical or artificial methods to supplement natural processes (draft TMDL, page 14)
- Potential need to address effects of evapotranspiration on flow (draft TMDL, page 9)
- Comments on wells in hydraulic continuity with the river were incorporated(draft TMDL, page 4)
- Effects of flooding on the establishment of vegetation (page 9)

It was commented that the public meetings during the comment period were held without the notification requested by the workgroup – specifically that residents and landowners on the Teanaway be notified by mail with a copy of the report enclosed and that the focus sheet, if used at all, state directly and up front (i.e., at the start of the letter) that the

meeting was to address important changes in the Teanaway. The public participation section [of the TMDL submittal report] should be revised to reflect this.

Response: Rather than mail the report to all residents of the Teanaway, Ecology sent a letter notifying them of the public workshops and indicating how they might obtain copies of the report. Ecology generally does not provide complete copies of reports to all residents in a watershed.

The (single-page) letter sent to residents had the more detailed focus sheet attached. The letter stated: "Your input is being sought… Ecology has prepared a report to address elevated temperatures in the Teanaway river basin…" Ecology considered the request by members of the workgroup to refer to important changes, but chose the more specific statement that the TMDL submittal report recommended implementation of existing regulations and voluntary measures.

A comment was made that the 303(d) list did not first include the Teanaway River. Listing criteria was changed to provide access to the TMDL process, activation of which was needed to support Bonneville Power Administration funding of the new tribal salmon hatchery experiment at Cle Elum.

Response: The 303(d) list is based on stream temperatures that exceed the state numeric standards, found at WAC 173-201A-030. Records show that stream temperatures in the Teanaway basin have exceeded state numeric criteria at eight locations.

It was commented that this report does not consider mechanical means of attaining any TMDL goals, such as stream channeling, barbs, groins or pool building, etc. Neither does it address artificial cooling with refrigeration units or other techniques such as shading by tunnel, awnings, or built shade apparatus.

Response: The draft submittal report includes the following statement (page 14): "It is expected that activities will focus on returning streams to natural conditions and the evaluation and use of mechanical or artificial methods to supplement natural processes, such as stream channelization, and alternative storage, are not excluded." Specific actions will be evaluated and selected during the development of the Detailed Implementation Plan.

There were some comments about implementation being part of the submittal report or specific suggestions about implementation.

Response: There is only a summary in the submittal dealing with implementation. The actual implementation planning will begin after EPA has approved the submittal with development of the DIP (Detailed Implementation Plan). EPA does not approve the DIP.

It was commented that while voluntary measures could assist in improving stream temperatures, there is no assurance that they will provide adequate conditions or be implemented to the degree necessary for stream recovery… We recommend that appropriate target temperatures, riparian and watershed conditions be set. Land practices

should then be required to be conducted in a manner that will attain these target conditions.

Response: The TMDL is to be implemented through existing regulations as well as voluntary measures (page v). As stated in the TMDL submittal report (page 22), if or when planned implementation activities are not producing expected or required results, Ecology or other entities may choose to do additional studies to identify the significant sources of heat input to the river. If the causes can be determined, additional implementation measures may be needed. This TMDL may be modified in the future based on significant changes or to accommodate adaptive management activities.

The purpose of the TMDL is to address stream temperatures. The TMDL establishes a goal of returning stream temperatures to more natural temperatures. Targets (called "allocations") have been set for stream temperature through the surrogate of shade (which incorporates the active channel zone width.) These allocations for shade may be considered to represent targets for riparian zones.

A comment was received asking for further explanation and verification of how the figures for shade were derived.

Response: Attainable shade for a mature riparian forest was calculated using the SSShade module of SSTEMP. This calculation used mature tree heights and crowns provided by the Cle Elum Ranger Station, a channel width equal to the active channel zone and the average azimuth for the segment measured from quad maps. (See the technical assessment, page 26)

It was commented that the TMDL did not determine buffer width needed, and yet relies on regulatory buffer widths for forestry practices and county critical areas. In fact, the forest practice regulations can allow some harvest up to the banks of perennial nonfish-bearing streams flowing into the Teanaway, its forks, or Stafford Creek. We recommend that shade targets be met along all perennial streams. Additionally, trees that provide shade to the stream, regardless of distance from the stream, should be left. At a minimum, trees should be evaluated for shade out to a distance of at least 100 feet.

Response: Ecology supports the use of the permanent forest practices rule ("Forests and Fish" report) to address water quality issues, including temperature. These rules include an adaptive management program to make changes to the rules in response to new information. Further study of the effectiveness of the riparian buffers in meeting water quality standards, both numeric and narrative, on Type N (non-fishbearing) streams is a high priority for Ecology.

Kittitas County Critical Area Ordinances (CAO) provide for a buffer zone of 40-200 feet. The presence of threatened, endangered or sensitive species or anadromous fish is to be considered in establishing the buffer width.

It was commented that contributions of sediment input and deposition from management activities were not quantified, even though the TMDL acknowledges their negative effects on stream temperature. A detailed assessment is planned as a component of the

implementation plan. We recommend that the assessment be done in the TMDL, and fine sediment targets set; not later in the implementation plan. The fine sediment effects on stream temperature need to be addressed early on in the TMDL.

Response: The effect of sediment on stream temperature was quantified through the load allocation made for shade. (The allocation for shade incorporated the effects of active channel zone width, and hence sediment, on shade.)

Further studies of sediment sources are planned, and will be performed as soon as funds are available.

The need to include funding sources that are secured in this draft was also commented on.

Response: Because of the nature of the funding processes, funding cannot be guaranteed. However, areas with an approved TMDL generally rate higher in the competition for Centennial Clean Water funding. Ecology is committed to identifying and obtaining funding, as demonstrated in its recent submittal of a grant application to compete for funding of additional studies and implementation activities in the Teanaway basin.

It was noted that it was stated that numeric standards do not apply for the Teanaway and the report talks about site potential shade without giving firm numeric goals.

Response: Numeric goals are provided in the section on load allocations. More details can be found in the technical assessment.

In the public workshop organized to discuss this document and in written comments it was indicated that some landowners along the Teanaway had made attempts to improve riparian stands along the river, often with futile results. Landowners also commented that they would appreciate assistance in planting trees and shrubs along the waterway.

Response: Ecology will work with local landowners, NRCS, and conservation district offices to find funding and develop methods to facilitate re-vegetation of riparian areas in the Teanaway Basin.

A comment states "subsequent computer modeling which indicates a temperature level that is not conducive to salmon propagation supports the failure of historical data to record empirical or anecdotal evidence of previous runs."

Response: This study did not evaluate whether natural temperatures were conducive to salmon propagation, or the historical presence or absence of salmon in the Teanaway basin, however, literature does suggest that the Teanaway was and probably did support runs of anadromous fish.

A comment states "…the imposition of heroic effort and implementation measures targeting agriculture and forestry seems designed to perpetuate and enhance regulatory process rather than address legitimate environmental problems. While the current emphasis on voluntary and existing measures is laudable, the proviso that results of monitoring may call for additional but as yet undisclosed measures negates the value of the emphasis and is not acceptable."

Response: The intent of the TMDL is to identify and implement the most effective measures to address elevated stream temperatures in the Teanaway basin. It is hoped and expected that implementing the TMDL as laid out in this plan will result in satisfactory improvements to stream temperature. If, after long term monitoring efforts indicate that conditions are not improving, Ecology, the Teanaway Advisory Group and landowners will begin discussions of other available alternatives.

A couple of comments expressed concern that buffers of narrow riparian strips will not be adequate to cool air temperatures along the river corridor.

Response: The microclimate cooling effect from forest cover is a secondary process to the shade provided by vegetation adjacent to the waterbody. It is hoped and expected that some microclimate cooling will occur with the proposed buffer strips. On forested lands subject to the Forest and Fish Act the state has committed to follow a path of adaptive management which requires monitoring and analysis to determine if prescribed practices do or do not meet environmental needs. This will be the case in the Teanaway.

Comments were received expressing the concern that inadequate attention was given to determining minimum instream target flows that will attain appropriate temperatures for fish. Further it was requested that Ecology determine and make a load allocation for flow as part of the temperature TMDL.

Response: Processes that determine appropriate levels of instream flow for fish usually incorporate a more complete set of fish habit needs, and are more likely to provide better overall fish habitat, than does addressing flow through temperature alone. This TMDL defers the decision for determining appropriate fish flows to other processes. As described in the report, changes in irrigation water diversion sites and the leasing and buying of water rights have resulted in improved flows in the Teanaway. Further, the Teanaway is a fully adjudicated basin and no further diversions will be permitted. Ecology will continue to promote the acquisition of water for instream flow through voluntary actions including, purchase, lease, trusts and relocation of diversions. Ecology has opted to not do TMDLs for waters listed for inadequate instream flow nor to include an allocation for flow in this TMDL.

A couple comments requested that the TMDL submittal to USEPA be delayed to allow time for additional studies to be completed.

Response: Ecology believes that the technical assessment and TMDL submittal report adequately identifies the primary human factors affecting stream temperature and that the data collected is adequate to define significant actions that can be implemented to help address stream temperatures in the Teanaway. The Summary Implementation Strategy recommends that additional studies be undertaken as implementation activities. Other studies may be proposed during development of the Detailed Implementation Plan (DIP). The local workgroup composed of members with a variety of interests and expertise will assist in developing the DIP. It is hoped that the result will be a meaningful, balanced approach.

Several comments asked why the role of fire in the forest environment was not included in the report.

Response: A paragraph has been added to the text acknowledging that fires probably did play a role in shaping the forest ecosystem, although little specific information is available. Future studies in the basin should consider the affects of fire where appropriate.

Concern was expressed over inclusion of an implementation plan with the TMDL submittal.

Response: Ecology has signed a Memorandum of Agreement (MOA) with the U.S. Environmental Protection Agency (EPA), regarding the implementation of Section 303(d) of the Clean Water Act (dated October 29, 1997). In this MOA, Ecology agreed to develop summary implementation strategies (SIS) for each TMDL, which would be submitted to EPA with the TMDL. EPA will check the submittal to see that a SIS has been prepared. However, the contents of the SIS are not subject to EPA approval. Per the MOA a "Detailed Implementation Plan" must also be submitted to EPA within a year of their acceptance of a TMDL.